Australasian Plant Conservation

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Canberra Nature Map

Ants, Seeds and Grassland Restoration

Linking Schools to Biodiversity Restoration

Suggested strategies for germinating recalcitrant seeds

Myrtle Rust – what's happening?

And much much more …

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Australasian Plant Conservation

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Australasian Plant Conservation is a forum for information exchange for all those involved in plant conservation: please use it to share your work with others. Articles, information snippets, details of new publications or research, and diary dates are welcome. There will be no special theme for the next issue. General articles on any plant conservation issue are most welcome. **The deadline for the September–November 2014 issue is Friday 15 August 2014.** The theme for the issue will be *Invasive Species and Biosecurity*. Please contact the editor, Huw Morgan, if you are intending to submit an article: editor@anpc.asn.au.

Authors are encouraged to submit images with articles or information. Please submit images as clear prints, slides, drawings, or in electronic format. Electronic images need to be at least 300 dpi resolution, submitted in at least the size that they are to be published, in tif, jpg or gif format. Guidelines for authors are at: http://www.anpc.asn.au/apc/APCGuideContrib.pdf.

Please send articles, no more than 1200 words, as a MS Word file (2000 compatible) by email to: editor@anpc.asn.au.

Front cover: Field kit for reducing risk of transporting Myrtle Rust (*Puccinia psidii*) and phytophthora (*Phytophthora cinnamomi*) between sites when collecting seeds. The kit includes a brush to clean dirt from shoes, a spray bottle containing 70 per cent methylated spirits for spraying boots, and a bucket to use as a bleach bath for footwear. The kit was available as a learning tool at one of the Australian Network for Plant Conservation's recent workshops—Seed collection, storage and use for native vegetation restoration—held in the Hunter Valley NSW in April 2014. Photo: Tricia Hogbin
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Regular features

From the editor

Huw Morgan

Welcome to the Winter 2014 edition of Australasian Plant Conservation. From an editorial perspective this is a very select issue, being the first in almost a decade not to carry a special theme. The last time the editorial team was bold enough to do this was in Spring (September–November) 2005. While the issue is not organised around a theme, it presents a range of great articles describing recent work in plant conservation. **Aaron Clausen** describes a new online tool developed for sharing, verifying and storing rare plant information, and which marks a milestone in the development of a committed plant conservationist, commencing with a bush epiphany. **Paul Gibson-Roy's** work features twice in this issue: the first article documenting what would appear to be interestingly high rates of seed removal by ants within a restored grassland; the second article, co-authored with **Anne Denham**, principal of Willmot Public School in Western Sydney, describing a program of activities run within the school with the aim of connecting children to nature and landscapes, and regenerating Cumberland Plain Woodland within the school itself. **David Hancock** gives us an insight into some of the hard-won trade secrets which allow his Perth-based native plant horticultural and bushland restoration businesses to stand out from the competition. Finally, **Bob Makinson** provides an authoritative and sobering review of Myrtle Rust in Australia, describing the present distribution of the pathogen and probing the efficacy and status of government and industry responses.

This issue also welcomes **Martin Driver**, who has just joined the Australian Network for Plant Conservation (ANPC) team as its new Project Manager. Martin's biography, included in this issue's *Member profiles* section describes Martin's broad range of skills and practical experience which he brings to this key position. As part of the Project Manager role, Martin will take charge of the valuable plant conservation workshops which ANPC runs throughout Australia—many readers who are planning on attending ANPC's future workshops will have the chance to meet Martin. I would also like to salute ANPC's departing Project Manager, **Tricia Hogbin**, whom many readers participating in recent ANPC workshops will have met. Aside from taking charge of ANPC workshops and all manner of project work, and being an all-round nice person, Tricia has been an invaluable contributor to *Australasian Plant Conservation*, particularly for the *Regular features* sections of the bulletin (including for this issue). Thank you Tricia!

Finally, in selecting an image for the cover of this issue, I decided upon a photo of the seed collector's pathogen management toolkit, taken by Tricia Hogbin at the *Seed collection, storage and use for native vegetation restoration* workshop, held in Kurri Kurri (NSW Hunter Valley) in April this year. Deployed in the field, the contents of the toolkit are used to manage the risk of spreading microbial pathogens (particularly Myrtle Rust and phytophthora) between seed collection sites. The image links to Bob Makinson's excellent Myrtle Rust review article in this issue, as well as foreshadowing the theme for the next issue of APC—Invasive Species and Biosecurity. I think the image also reminds us of the practicalities and considerations required to be successful plant conservationists, and of the levels of care we must take to safeguard native flora. My apologies to any readers who are reminded of their outstanding housework!

Canberra Nature Map: an online community discovering and recording Canberra's floral treasures

Aaron Clausen

Site Administrator and Founder, Canberra Nature Map (www.CanberraNatureMap.org), Watson ACT. Email: aaron@at3.am

As an avid mountain biker, I will honestly admit that I used to ride through what I now know are 'unofficial' and illegally formed tracks through various parts of Canberra Nature Park, primarily in and around my own local area within Mount Majura. And if you had confronted me about it, I would have most likely assumed that you had nothing better to do or perhaps needed to 'get a life'. What harm could my trusty bike possibly do to a dry, dusty old trail through some relatively boring bush?

I was happy in my comfy little place of complete ignorance.

However, on one particular crisp September day in 2013, I briefly dismounted to take a rest, laying my bike down on the surrounding vegetation while I stomped around on foot. I noticed something unusual and yellow shining vibrantly. Upon closer inspection, I had found a Leopard Doubletail Orchid (*Diuris pardina*) and thought to myself 'wow, this might be one of those wild bush orchids'. After taking several photos with my phone camera, I almost stepped on an unquestionably perfect Wax Lip Orchid (*Glossodia major*) as I trudged back to my bike.

My curiosity was stirred.

So I came back again the next day and found a few more Wax Lips and Leopards, but had no idea about what was about to take place. A transformation of the old, ignorant mountain biker me into the new, reformed, orchid-consumed me. I found myself standing right in the middle of a huge patch of the critically endangered Canberra Spider Orchid (*Caladenia actensis*). The beauty of the first plant I spotted was astonishing and it was quite a surreal moment. The more I looked around, the more tiny, stunning spider orchids I noticed all staring up at me, almost as if to say, 'you almost rode over us, but we still love you!'.

That was the last day I rode my bike on an unofficial trail.

I counted up to 25 spider orchids in that colony and my ignorant perceptions of Canberra's relatively boring outdoors were shattered. I felt so proud to live so close to something so beautiful that I never knew existed for all these years, something that I could come and visit any time even if it was to just stare in amazement again and again. The spider orchids had me so captivated that within a week I had purchased a fancy new camera and would return to the spot regularly to monitor their development. I contacted the Friends of Mount Majura (FoMM) Parkcare group for advice as they knew the local area best. I'm glad I did as FoMM Coordinator, Waltraud Pix, seemed to be similarly excited about the species and was extremely generous with her time and the sharing of her deep knowledge of the area.

*The critically endangered Canberra Spider Orchid (*Caladenia actensis*).*

I'd heard about an upcoming ACT Centenary Bioblitz biological survey and decided to attend as a way to try to learn more about my newly found interest. I joined a rare plant group led by Dr Michael Mulvaney of the ACT Government's Conservation, Planning and Research unit. Members of the group ranged from formally qualified botanists to ex-park rangers - as a software engineer I was well and truly out of my comfort zone. I learnt about the methods used for performing rare plant surveys, capturing GPS coordinates, approximating abundance and species identification. We located dense clusters of Large-Spotted Sun Orchids (*Thelymitra juncifolia*), Golden Pomaderris (*Pomaderris intermedia*) and a whole raft of other rare plant species.

This was great fun!

After the Bioblitz and armed with some handy rare plant field guides supplied by Michael Mulvaney, I continued searching for rare plants, photographing my sightings and recording the GPS locations. I would email my sightings through to Dr Mulvaney for assistance with identification and so they had a record of any significant sightings. Before long, I was spending more time inside excel spreadsheets and image editors than I was looking for actual plants. I had so many photos and GPS coordinates that I needed a better way of managing it all and getting the information through to the ACT Government.

In my spare time, I began to develop a database to store the information so that it could be hosted securely online and easily accessed. Over the 2013 Christmas holidays, this tinkering evolved into the Canberra Nature Map. But I knew that an online database was very limited in what it could achieve without the right custodians and community to nurture and manage it. So it was crucial to get the right people on board to ensure the project was in good hands and had a healthy core. Michael Mulvaney and I discussed some ideas and approached a number of trusted individuals across the ACT to come together and act as moderators and local experts. People who are passionate about a particular place often become experts with the plants that can be found in that place. The model works by providing these local experts with elevated access privileges for their local area, which in turn helps others learn about the biodiversity in these areas. Species identifications are discussed and ideas are exchanged openly in an educational way. This validation process increases the accuracy of the digital records, which are then fed through to government.

In this sense, the project has been a very innovative way of showing how a private initiative can essentially partner with and work in unison with government. Government traditionally has a reputation of being slow to innovate, but I think the ACT Government have shown a lot of leadership by being open to the whole concept and taking an active role in shaping and guiding the project.

In the six months since the map's launch (on 27 Dec 2013), several significant new discoveries have resulted, which have only been made possible due to the knowledge transfer that's taking place. New discoveries include confirmed sightings of the Large Autumn Greenhood (*Diplodium revolutum*) and Nodding Greenhood (*Pterostylis nutans*) at Mount Majura—two species not previously known to exist on the mountain—as well as positive confirmation of a Rasp Fern (*Doodia australis*) at Black Mountain which may be a first for the ACT.

What is Canberra Nature Map?

The Canberra Nature Map is a repository for park care groups, volunteers and members of the public to report sightings of rare and endangered plant species and any of the many botanical treasures that Canberra's nature parks are home to. The web address for the Canberra Nature Map is: www.CanberraNatureMap.org

Objectives

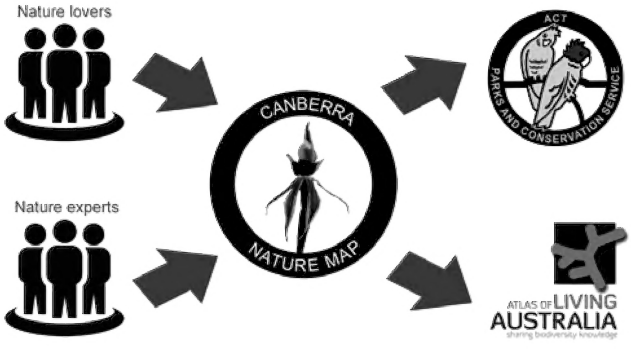
Canberra Nature Map's three objectives are to:

- Accurately map every rare plant in the ACT and maintain records for future generations.
- Improve public education and awareness of the plant diversity and significance of Canberra's Nature Parks.
- Influence development decisions and protect Canberra's treasures by providing critical species location data to the ACT Parks and Conservation Service.

How it works

The way Canberra Nature Map works is summarised in the following six steps:

- Nature lovers report their rare plant sightings and upload photographs.
- The Canberra Nature Map community and its nature experts moderate and comment on the sightings. Moderation involves reviewing reported sightings and ensuring correct identification while providing local expertise and guidance to users.
- An accurate species identification is discussed and confirmed.
- Meanwhile, the general public are reading and learning about Canberra's treasures and the plants which occur in the places that they hold close to heart.
- High quality rare plant sighting information is sent to the ACT Government Conservation Planning and Research Unit and the CSIRO Atlas of Living Australia.
- This knowledge is fed into planning, development and conservation management decisions.



Schematic representation of the Canberra Nature Map workflow. Nature lovers and experts enter information into the map. Following expert review, information is provided to the ACT Government and the CSIRO Atlas of Living Australia.

Ants, Seeds and Grassland Restoration

Paul Gibson-Roy

Chief Restoration Ecologist, Greening Australia, NSW. Email: pgibson-roy@greeningaustralia.org.au

Background

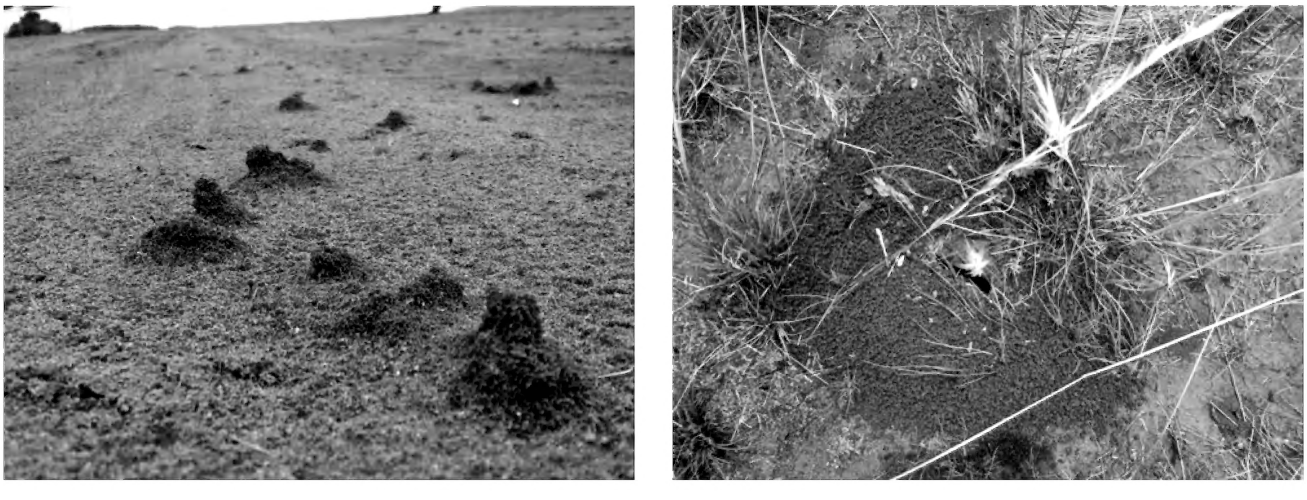
Seeds represent the key mobile stage of vascular plant life and plant species have evolved many successful strategies for dispersing seed. Successful dispersal and persistence of seed are critical for a species, population or genotype to survive (Long et al. 2014). Effective dispersal strategies may harness abiotic (e.g. wind and water) or biotic (e.g. birds, mammals and insects) factors. Humans are prolific dispersers of seed either consciously (e.g. agriculture and restoration) or unconsciously (on machinery, in fodder or on livestock). Seeds contain nutrients and other products that are of use to the embryonic plant, as well as to other organisms, including seed dispersers, as food resources. Seed predation can be very high (>90 per cent of a plant crop), particularly when it is concentrated on species which may be dominant in a community (Crawley 1992). However, high levels of predation may not significantly impact on recruitment unless recruitment is limited by seed number. Successful seed dispersal also ensures the health and survival of parent plants, and successful dispersal strategies:

- Reduce the incidence of predators or pathogens in the vicinity of the parent;
- Increase the likelihood of species survival in spatially variable environments;
- Reduce intergenerational competition (between seedlings and their parents);
- Increase the likelihood that seeds arrive at sites amenable to seed germination and seedling establishment (Fenner and Thompson 2005).

Ant Dispersal

Ants play a role in many successful seed dispersal strategies, particularly in Australia which is home to a rich diversity of ant species. Fenner and Thompson (2005) suggest ant dispersal of seed is a form of mutualism in which the plant is rewarded by dispersal and the insect with a food resource. Many plant species rely on ant dispersal. Some species, particularly acacias, have developed oily structures on the seed surface called an elaiosome, which are attractive to ants. Seeds of non-elaiosome producing herbaceous species are also utilized by ants. Handel et al. (1981) reported that the majority of herb species in forests of the eastern US were ant dispersed. In both these examples, ants move some component of the seed crop to their nests. This is often located away from the parent, where competition from the parent or siblings can be high, and where predation from other animals is more concentrated. It is away from these threats, and buried in or near the surface of mounds, that some seeds will germinate and seedlings establish.

Many times walking through grasslands restored under Greening Australia's Grassy Groundcover Restoration Program (GGRP; Gibson-Roy and McDonald 2014) I've observed ants at work and wondered at the role they play in restoration success. A US study comparing restored and remnant grasslands in South Dakota found that ants play an important ecosystem role in soil aeration, nutrient cycling, seed dispersal and plant defence (Winkler 2014). Ants also provide a food source for other trophic levels including reptiles and birds. Interestingly this study also found that



Ant mounds on newly prepared grassland restoration site (left) and an ant nest in among a restored sward (right). Photos: P. Gibson-Roy.

ant diversity increased with the age of a restoration, and that the more diverse the ant populations, the closer a restored grassland resembled a remnant grassland.

Like those US restored grasslands, GGRP sites were established by direct seeding on ex-agricultural land. We know that where nutrients are low or have been restricted, these techniques allow the establishment of species-rich native grassland (Gibson-Roy et al. 2010). In established GGRP sites there are numerous sightings of mammals, birds, insects and amphibians occupying niches. Ants are among the first visible colonisers, and are also prominent in later established communities, in each situation contributing to system complexity.

On a number of occasions I have observed ants taking seed into nests and seedlings emerging from around ant mounds. Prior et al. (2014) suggest the moist and humid micro-climate inside ant nests favour seed germination and establishment. Interested by these ideas and observations I set up a simple study to investigate if and what seed was taken by ants as part of a larger direct seeding experiment (Gibson-Roy 2000).

Procedure

The experiment used seven grassland species; a grass (Common Wallaby Grass—*Rytidosperma racemosum*) and six forbs (Bulbine Lily—*Bulbine bulbosa*, Common Everlasting—*Chrysocephalum apiculatum*, Hoary Sunray—*Leucochrysum albicans* subsp. *albicans* var *tricolor*, Native Flax—*Linum marginale*, Scaly Buttons—*Leptorrhynchos squamatus* and Tall Bluebell—*Wahlenbergia stricta*). All were hand sowed as mixed or single species plots. Following sowing, plot surfaces where lightly covered with vermiculite to provide protection from dehydration and predation. At the same time 21 clear plastic petri dishes containing seeds of each species were randomly located among the thirty-six 1 m x 1 m experimental plots. Each petri dish contained ten seeds from one species (replicated three times). Two 2 mm holes were drilled into opposite sides of the dishes allowing entry of ants, but not larger animals (e.g. birds or mice). The number of seeds within the dishes was monitored for three weeks.

Outcomes

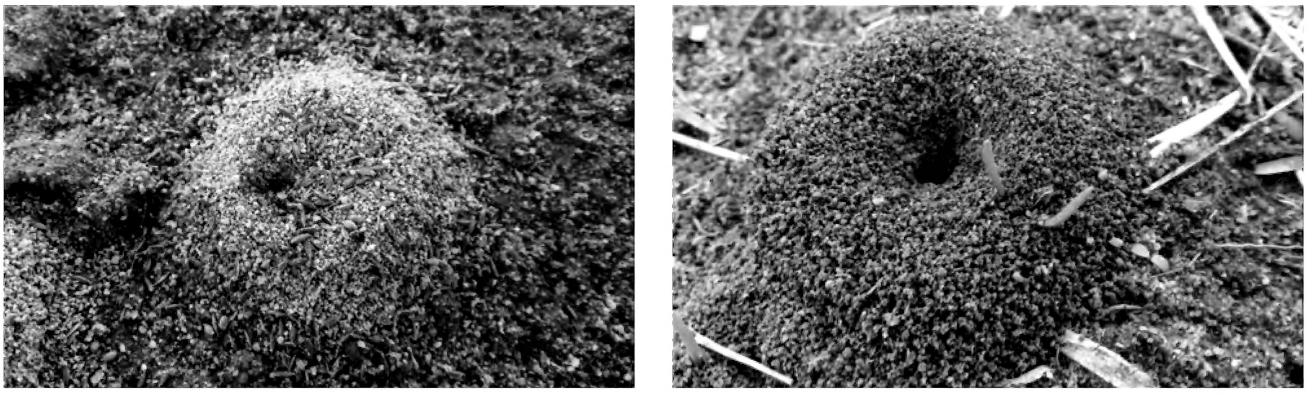
Ants removed a considerable proportion of seed of each species from petri dishes during the three week period. Seeds of Native Flax were most taken, with 97 per cent of seeds removed, while Wallaby Grass was the least removed (40 per cent of seeds taken). Among the daisies the community dominants Common Everlasting and Scaly Buttons were removed by 93 per cent and 80 per cent respectively, while the threatened Hoary Sunray was removed by 77 per cent. Bulbine Lily was also markedly impacted, with 90 per cent of seeds taken. Finally, Tall Bluebell was somewhat less impacted with 57 per cent of seeds removed.

Discussion

Are these findings surprising? Perhaps not. There are many reports of seed removal by ants. As noted above, ant removal and dispersal may result in increased distance and reduced competition between seedlings and parents. Over the ensuing weeks I also observed numerous seedlings of the sown species emerging from around and within ant mounds located near the plots, in particular Bulbine Lily. These seedlings may have originated from seed taken from the petri dishes or from seed sown as part of the larger experiment.

Seed removed by ants from sealed petri dishes over three week period. Original number of seed in each petri dish was ten (three replicates per species). Columns show average number of seeds per dish remaining at the end of each week and standard deviation (SD).

	Week 1		Week 2		Week 3	
	Average number of seeds remaining per dish	**SD**	**Average number of seeds remaining per dish**	**SD**	**Average number of seeds remaining per dish**	**SD**
Bulbine Lily	**6.3**	5.5	**6.0**	5.2	**1.0**	1.7
Common Everlasting	**5.0**	5.0	**1.7**	2.9	**0.7**	1.2
Scaly Buttons	**8.0**	2.6	**4.3**	4.0	**2.0**	3.5
Native Flax	**3.0**	5.2	**0.3**	0.6	**0.3**	0.6
Hoary Sunray	**6.7**	5.8	**6.7**	5.8	**2.3**	4.0
Common Wallaby Grass	**9.0**	1.0	**7.3**	0.6	**6.0**	2.0
Tall Bluebell	**9.7**	0.6	**7.0**	2.0	**4.3**	4.5



Seed taken by ants to their mound following seeding (left) and seeds germinating in an ant mound (right). Photos P. Gibson-Roy.

This study confirmed that seed from each of the seven grassland species was taken by ants. This information alerted me to the likelihood that most species we selected for our restorations might also be taken and possibly consumed by ants. Is this something to be concerned about? I don't think so. As discussed, in return for a food resource, ant dispersal offers many benefits to a plant species. Unless the mass of seed sown for any given species in a restoration is extremely small, it is unlikely that ant removal and consumption would significantly impact on its establishment success. Seed death due to consumption, pathogens or lack of appropriate germination conditions is common in remnant communities. In restoration, it is by sowing seed at appropriate times, using viable seed in sufficient volumes, preparing appropriate seed beds and ensuring good seed-soil contact that practitioners hope to ensure enough seed survives to germinate and establish as plants. This has been the case in our GGRP restorations. In the meantime I am more than happy to share some of the seed we sow with other organisms such as ants—we are trying to restore complex and functioning ecosystems and their presence is welcome.

Ant on a Grampian Daisy within restored grassland. Photo P. Gibson-Roy.

References

Crawley, M. (1992). Seed predators and plant population dynamics. In *Seeds: The ecology of regeneration in plant communities*. 1st Edition, M. Fenner (ed). CAB International. Wallingford. pp. 157-191.

Fenner, M. and Thompson, K. (2005). *The ecology of seeds*. Cambridge University Press, Cambridge.

Gibson-Roy, P. and McDonald, T. (2014). Reconstructing grassy understories in south-eastern Australia: interview with Paul Gibson-Roy. *Ecological Management and Restoration* 15(2): 111-122.

Gibson-Roy, P.G. (2000). *An investigation of the germination and establishment potential of selected species from the basalt plains grassland community as indigenous seed mixtures.* Honours Thesis. Institute of Land and Food Resources, The University of Melbourne, Melbourne.

Gibson Roy, P.G., Moore, G., Delpratt, C. J. and Gardner, J. (2010). Expanding horizons for herbaceous ecosystem restoration: the Grassy Groundcover Restoration Project. *Ecological Management and Restoration* 11(3): 175-185.

Handel, S.N., Fisch, S.B. and Schatz, G.E. (1981). Ants disperse a majority of herbs in a mesic forest community in New York State. *Bulletin of Torrey Botanical Club* 108: 430-437.

Long, R. L., Gorecki, M.J., Renton, M., Scott, J.K., Colville, L., Goggin, D.E., Commander, L.E., Westcott, D.A., Cherry, H. and Finch-Savage, W.E. (2014). The ecophysiology of seed persistence: a mechanistic view of the journey to germination or demise. *Biological Reviews* doi: 10.1111/brv.12095.

Prior, K.M., Saxena, K. and Frederickson, M.E. (2014). Seed handling behaviours of native and invasive seed-dispersing ants differentially influence seedling emergence in an introduced plant. *Ecological Entomology* 39(1): 66-74.

Winkler, L. (2014). *Restoring grasslands: ant diversity indicates restored grasslands*. South Dakota State University Accessed 9 June, 2014, from www.sciencedaily.com/releases/2014/06/140609140500.htm.

Linking Schools to Biodiversity Restoration: The Willmot Public School Connecting the Cumberland Program

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Vanishing Cumberland Plain Woodland

Western Sydney is one of Australia's fastest growing and most densely populated areas and much of this growth is occurring on the Cumberland Plain. This region extends to Windsor in the north, Picton in the south, and from the Nepean-Hawkesbury River at the base of the Blue Mountains to the inner west of Sydney. Occupied by Indigenous peoples for millennia, and much more intensively by Europeans and other settlers since 1788, native vegetation of the region is now highly threatened by changing land use practices including encroaching urban development. Only 13 per cent of the pre-1750 extent of Cumberland Plain Woodland remains intact and the community is listed as Critically Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the NSW *Threatened Species Conservation Act 1995*.

As land on the Cumberland Plain continues to be converted for urban and business opportunities such as designated Growth Centres, there is a critical need to develop effective methods to restore Cumberland Plain Woodland. Ensuring the long-term survival and protection of natural ecological communities to Sydney's west was cited in the Cumberland Plain Recovery Plan (2010) as a major challenge facing natural resource management in NSW. To this end, and with crucial funding support from the Commonwealth and State governments, Greening Australia (GA) and its project partners have initiated two concurrent programs that focus on restoration of this community. These include the establishment of regional seed production infrastructure to provide restoration seed resources and a series of large-scale direct sowings (to a total of 40 ha) of ground layer species.

Linking to schools

Landscape restoration can be quite a technical subject, relating to methodologies, machinery, site preparation, plants, seed, and site management. However, those involved in the sector realise it is also about people and how they perceive or are engaged in a restoration program. Experience has shown that effectively engaging with local communities can make the difference between satisfactory and wonderful outcomes. For this reason GA initiated a schools program in partnership with Willmot Public School and The University of Western Sydney (UWS) Discovery Centre to harness the energy and enthusiasm of young people and to involve them in ecological restoration.

The program was called Connecting the Cumberland. As well as engaging students in restoration with a biodiversity focus it sought to increase their understanding of the native and built landscapes of Western Sydney. With wonderful support from Willmot teachers, GA and Discovery Centre staff over several months, students from years three to six developed visual, oral, written and musical work which focussed on the plants, animals and humans of the region, from earliest times through to the present day. Willmot Public School has a large Indigenous student cohort, and the project was able to draw extensively on wonderful local knowledge from local Indigenous community members. It was also assisted by the input of the school's Aboriginal Education Officer (Sandra Hickey) who helped develop relevant cultural activities and lessons.

Integrated into the curriculum over two terms, students were able to explore the many and complex issues relating to the ecology of their local region. Why are native species under threat? Why do landscapes need restoration? How can we create habitat for other species within our urban communities? Students also considered the many human-related issues from the region. Why do we build our suburbs the way we do? Why are they sometimes pleasant places and why are they sometimes not? How can we change those that are not for the better? This led them to consider the various challenges facing their and future generations. A primary goal was to enable students to reflect on what actions humans could undertake to better live amongst and respect the natural world. At the completion of the program students were able to showcase their considerations and deliberations through artworks, visuals, audio and musical projects at a major public exhibition running from May to August at the UWS Discovery Centre (Richmond Campus). Finally, all these outputs were collated and showcased in a published book *Because Ecosystems Matter: Stories of the Cumberland Plain* (2014).

Students working with Mike Yates and Dave Warren on an original musical composition that features the Cumberland Plain. Photo: Rafiqul Huq.

School-scale restoration

A sub-component of the program was a restoration project with a strong biodiversity focus at the school itself. Willmot Public School grounds support a discrete patch of good condition native eucalypt canopy. But like much of western Sydney, there was little or no native ground layer underneath. To address this, the restoration project was able to utilise resources of the Cumberland Seed Savers Program (CSSP). In partnership with the NSW Office of Environment and Heritage and Greening Australia, the CSSP had established a regional seed production facility at the University of Western Sydney (Richmond Campus) growing many rare ground layer species from the region. Using seed produced from these native crops we grew more than 1,000 plants from over 20 species for installation at Willmot. Access to these locally rare native plants provided a unique learning and experiential opportunity for the students and school community to restore an area of diverse wildflower Cumberland Plain Woodland literally in their own backyard.

Planted species were chosen for beauty and function, and many had attractive flowering features such as the Chocolate, Vanilla, Fringe and Bulbine Lilies (*Arthropodium milleflorum*, *Dichopogon fimbriatus*, *Thysanotus tuberosus*, and *Bulbine bulbosa*). Others, including the New Holland Daisy (*Vittadinia* sp.) and Native Bluebells (*Wahlenbergia* spp.) produce seed in large number, which are likely to spread at the site and over time increase plant populations. Seed from the installed plants can also be collected by students and used to restore new areas. Some species, such as Kangaroo Grass (*Themeda triandra*) provided structure and context. In all, there was a rich array of species available and these were installed over two days, involving half of the school's 200 pupils. The level of enthusiasm and engagement from the students was something to behold. Training and instruction in how to plant was given and very much heeded. Teachers and GA staff were thrilled and impressed at how seriously each class took the responsibility of installing plants so that they might survive. Importantly, the children showed a great capacity and enjoyment for working alongside and assisting their fellow class mates in this restoration adventure.

People and restoration

Many weighty issues preoccupy society including inequality, poverty, and intolerance. In light of these important but essentially human-centric conundrums, perhaps the great challenge for our plant conservationists is to better articulate why society should also be concerned about the plight of our natural world. If we are to ever hope this can be achieved in a meaningful way we have no choice but to harness the support, understanding and input of the broader community. We must engage with our youth as the citizens of tomorrow—they inherit the problems of today.

The Connecting the Cumberland Program has been an attempt to do just this—link ecological restoration via our youth to the broader community. It is certainly not the first or the only project of its type. We hope there are many others. Our experience working with these young students has shown they are entirely capable of understanding complex issues surrounding the management of our natural landscapes, particularly those in urban settings. The students also created an impressive body of artistic, musical and audio visual work, now displayed as part of an exhibition and in a published form that will no doubt inspire their peers and adults alike. Finally they have engaged in practical, hands-on ecological restoration, returning rare native ground layer species to their school grounds. In all these areas they made important steps towards changing the way they contemplate and live alongside the natural world.

References

Department of Environment, Climate Change and Water (NSW). (2010) *Cumberland Plain Recovery Plan*, Department of Environment, Climate Change and Water (NSW), Sydney.

Willmot Public School. (2014). *Because ecosystems matter: stories of the Cumberland Plain*. Office of Sustainability, University of Western Sydney. ISBN 978-1-74108-315-6.

Students from grades three to six revel in the opportunity to install a wildflower meadow under the eucalypt canopy at Willmot Public School. Photos: Rafiqul Huq.

Suggested strategies for germinating recalcitrant seeds

David Hancock

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Abstract

This article provides practical strategies for germinating seeds of recalcitrant and difficult species. These strategies are refined from knowledge and experiences accrued over 15 years within my propagation and restoration work based in Perth, Western Australia (WA). Natural Area Consulting Management Services, founded in 2003, now employs over 50 full-time staff and is active in all areas of on ground environmental management including plant propagation for restoration projects both in house and managed by others. This article represents a précis of a larger presentation I made in May 2014 to the International Plant Propagation Society Conference, Wellington, New Zealand.

The Western Australian propagation market

Western Australia is home to 13 500 native plant species. Informal enquiry to knowledgeable sources suggests that less than half of these have likely ever been propagated. The Perth plain is home to around 2 200 species, 50 per cent being endemic to southwest WA. Many exhibit high levels of seed dormancy and successful germination techniques for many are not well documented. Generally, no more than a third of Perth Plain species would be available in the market at any one time and even when they are, often only available in low numbers.

The Perth propagation market is full of challenges and opportunities. Germination and propagation from seed are considered the best source material for restoration and rehabilitation outcomes (Turner & Merritt, 2009) and our revegetation experiences support this; plants propagated from cuttings generally do not perform as well in dryland revegetation. Tissue culture is useful for producing some species essential for restoration but is not always cost recoverable when small numbers are involved. Generally tissue culture propagation is only viable in large volumes or where ongoing demand for the particular plant exists, often in long haul post mine site restoration work.

I commenced propagating 15 years ago and soon realised that there were many species that we did not know how to propagate, these species being important to meet project goals in our restoration business and the broader market. Literature to provide definitive direction on germination of many species was either incomplete or did not exist.

My companies take the view that our reputation and our returns will be enhanced by tackling the hard to grow species. This often involved unconventional approaches and a willingness to experiment and speculate. This has been a long road, starting from a low knowledge base. We are now seeing the benefits flow from the early decision and ongoing work. Many of the species that we thought impossible to germinate in the early years are now within our capability.

The major impediments to successful seed propagation that we have encountered include difficulties due to various forms of seed dormancy, variable seed viability, physical difficulties encountered when seed cannot be readily isolated from the host plant and lack of seed supply from commercial providers due to an avoidance in collecting certain species because it is uneconomic to do so.

Some lessons learnt about germinating recalcitrant seeds

Experience has shown us that:

- seed from contracted collectors who are not propagators will often perform poorly;
- seed collected from different locations and at different times can show significant variation in viability;
- propagating native species requires specialist understanding, particularly of on ground habitats;
- obtaining vegetative material (seed and cuttings) requires rigorous pursuit of collection opportunities, e.g. land clearing applications and seed collection opportunities;
- serious work in this area requires the propagator to be involved directly in the seed collection decisions and processes.

Our approach to determining a germination method for a novel species

Phase 1: Preliminary investigation

Our normal approach is, at the outset of each propagation season, to establish a schedule of additional recalcitrant target species whose germination requirements we would like to discover. These species are determined by client and company project demand, additional work on past failures as well as some degree of speculation as to likely market requirements. We set challenging assignments to our propagators every season.

For each new species under investigation, we apply the following established protocols and preliminaries:

- Study all available local literature and references to the species. If a germination method has been determined for another species in the genus, this may be a good guide as to what method might be successful for the target.
- Pursue botanical gardens authorities or universities for their research and practical experience—it is often publicly funded and therefore should be available to propagators.
- Review International Plant Propagation Society references (membership required) and records of other similar bodies (botanical journals).
- Discussing success in germinating similar genera in other jurisdictions, for us, in the eastern states.
- Studying the species across the breadth of its natural habitat to understand and replicate the natural conditions during germination. For example, some species require immediate sowing after collection or viability can be lost rapidly. Some species are noted to be germinating at unusual times and others are obviously trapped beyond germination depth for long periods and await disturbance, e.g. *Exocarpos* spp. Understanding the natural progression to germination can assist in devising a propagation method.
- Collecting and buying seed from a wide range of locations. In any one season we collect seed from a range of species from over 200 sites in and outside Perth. Due to this, we have gained good knowledge on the more viable seed producing areas.
- If we cannot isolate seed, taking the mature seed head and processing it as is.
- We have never accepted that propagation from seed for any species is not possible. Our philosophy is to never, ever give up.
- Maintaining detailed and accurate propagation records and techniques employed, and documenting successes and failures.
- Informing staff of their responsibilities to protect the company's intellectual property.

Phase 2: Propagation method determination and refinement

Following gathering of information and seeds as described above, we then begin the discovery work, through a process of 'informed trial and error', determining a method for germinating the seed.

We apply the following propagation processes and treatments to seed which can be isolated from floral structures:

- Weathering of seed.
- Manual scarification (small numbers).
- Hot and or cold water treatment (often repetitive).
- Concentrated sulphuric acid exposure.
- Extended conventional sowing (have patience, don't throw out those seed trays!), seed trays are often retreated for up to five years.
- Temperature stratification, hot and/or cold.
- Variable temperature stratification.
- Extended imbibition (de-ionised or rain water with wetting agent or smoked water), it may be unconventional but we have had high success in some cases from soaking particular seed for up to 14 days.
- Smoke (suspended in air, not water), often for extended periods up to one week.
- Heat; we are surprised by the resilience of some seeds to high heat and for extended periods (100 °C and beyond) and the response.
- Light, some seeds require light to germinate and a carefully controlled surface sow is essential
- Extended burial and light deprivation.
- Inoculants and fungi are added to selected species.
- Exposure to plant hormones, e.g. gibberellic acid, jasmonic acid and abscisic acid.

Seed weathering trays. Photo: David Hancock.

Our most notable successes have been achieved by combining a variety of some of the above steps, many of them seemingly unlikely at the outset. Sometimes the most radical of methods has surprised us, one notable example being *Acanthocarpus preissii* for which the literature suggested warm stratification was most likely to succeed. As this did not give us the desired result, we switched to extreme cold treatment, together with smoke treatment and variable cold stratification for outstanding and readily replicated results.

Some species (e.g. *Frankenia* spp., *Triodia* spp., and *Spinifex* spp.) hold seed for extended periods and isolation of seed is either very difficult or not a commercially viable prospect. The solution may be to depart from the desire to isolate clean seed, harvest the entire seed head, and sow en masse. We have had outstanding success with a good number of species using this method.

Species considered recalcitrant or often difficult for which successful propagation has been achieved.

Family	Genus	Species
Apocynaceae	*Alyxia*	*buxifolia*
Laxmanniaceae (including Lomandraceae)	*Acanthocarpus*	*preissii*
	Laxmannia	*squarrosa, maritima*
	Dichopogon	*capillipes*
Chenopodiaceae	*Atriplex*	*cinerea, isatidea, hypoleuca*
	Halosarcia	spp.
Cyperaceae	*Baumea*	*articulata, juncea, preissii*
	Chorizandra	*enodis*
	Cyathochaeta	*avenacea*
	Cyperus	*gymnocaulos*
	Gahnia	*trifida*
	Lepidosperma	*gladiatum, effusum, longitudinale, persecans, calcicola*
Dasypogonaceae	*Dasypogon*	*bromeliifolius*
Dilleniaceae	*Hibbertia*	*hypericoides, subvaginata*
Epacridaceae	*Brachyloma*	*preissii*
Ericaceae	*Leucopogon*	*conostephioides, parviflorus, propinquus*
Frankeniaceae	*Frankenia*	*pauciflora*
Haemodoraceae	*Phlebocarya*	*ciliata*
Iridaceae	*Orthrothansus*	*laxus*
	Patersonia	*occidentalis*
Loganiaceae	*Logania*	*vaginalis*
Loranthaceae	*Nuytsia*	*floribunda*
Myrtaceae	*Scholtzia*	*involucrata*
Poaceae	*Spinifex*	*hirsutus, longifolius*
	Sporobolus	*virginicus*
	Triodia	*epactia, wiseana*
Proteaceae	*Conospermum*	*stoechadis, triplinervium*
	Stirlingia	*latifolia*
Ranunculaceae	*Clematis*	*linearifolia*
Restionaceae	*Desmocladus*	*flexuosus*
	Dielsia	*stenostachya*
	Hypolaena	*exsulca*
	Lepidobolus	*preissianus*
	Lepyrodia	*glauca*

Mass sowing and germination. Photo: David Hancock.

Target species for future work

We have had either no or very limited success with the following species; we would consider these an essential part of high-level restoration work in our market. Some have been propagated via tissue culture but we remain optimistic that they can be returned via seed:

- Ericaceae; *Astroloma* spp. and *Conostephium* spp.
- Myrtaceae; *Calytrix* spp. (volume production required)
- Cyperaceae, sedges including *Mesomelaena* spp., *Schoenus* spp. and *Tetraria* spp.)
- Lilaceae; *Tricoryne* spp.

Additional methods employed to improve propagation outcomes:

- Use of enzymes, similar to those used in viticulture to remove thick fleshy coats.
- Treating seed with fungicide on species prone to fungal attack, e.g. *Grevillea* spp.
- Add wetting agent to the soaking medium when preparing to soak seeds to assist imbibition.
- Using granulated fungicide in potting media for fungal and damp prone species.
- Applying hormone to root cut division to improve survival; Clonex® works well for us.

Conclusion

Our experience suggests that continued experimentation will eventually lead to improved seed germination rates and more often a combination of treatments can make the difference. Not only can perseverance pay off for recalcitrant species but germination yield for easier species can be improved by continued trialling. We don't get too carried away with the science behind all this. We are not doing research; we are working to achieve an outcome, a business result and one that we can learn from.

References

Turner, S., and Merrit, D. (2009). Seed germination and dormancy. In C. Offord and F. Meagher (Eds.), *Plant germplasm conservation in Australia* (1st ed., pp. 87-108). Canberra: Australian Network for Plant Conservation (ANPC) in partnership with Australian Seed Conservation and Research (AuSCaR), Canberra.

Myrtle Rust – what's happening?

Bob Makinson

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The story so far

Puccinia psidii (Eucalyptus Rust or Guava Rust, in Australia also known as Myrtle Rust) is an exotic rust fungus of South American origin. It attacks plants of the family Myrtaceae only, which includes Eucalypts, Tea-Trees, Bottlebrushes and Lillipillies. Recognition guides and other material are on the Web:

www.daff.qld.gov.au/plants/health-pests-diseases/a-z-significant/myrtle-rust

www.dpi.nsw.gov.au/biosecurity/plant/myrtle-rust

www.depi.vic.gov.au/agriculture-and-food/pests-diseases-and-weeds/plant-diseases/shrubs-and-trees/myrtle-rust.

The *Puccinnia psidii* pathogen has long been known overseas to infect some Myrtaceae of Australian origin, mainly Eucalypts in South American plantations. Plant pathologists had regarded it as a potential threat to native Australian Myrtaceae species, to Myrtaceae-dominated ecosystems, and to industries dependent on plants of this family. *P. psidii* gradually moved closer to Australia in the 2000s: to California and Hawaii in 2005, then to Japan and southern China in 2009. Plant Health Australia published an Australian Contingency Plan for Eucalyptus Rust in 2009.

Myrtle Rust was first detected in Australia on the New South Wales Central Coast in early 2010. Since then it has spread and naturalised along the east coast from Narooma in NSW to Cooktown in North Queensland, mostly in low-elevation coastal areas but extending further inland to the mid-upper Clarence Valley of NSW, the Toowoomba area in south-eastern Queensland, and onto the edge of the Atherton Plateau in North Queensland. There are no naturalisation records west of the Great Dividing Range so far. There have been numerous Victorian occurrences, mainly in the Melbourne-Geelong area in cultivation and the 'greenlife' industries, but it does not yet appear to have naturalised in bushland in that State, where an active containment and eradication strategy is being run by the Victorian Department of Environment and Primary Industries and partners. Myrtle Rust is nevertheless regarded there as an 'endemic disease'.

Other Australian States are not yet affected, but all predictive models to date show warm/moist areas in all States to be at risk of Myrtle Rust naturalisation, albeit with considerable uncertainty for the non-rainforest tropical coasts. The pathogen is also a threat to Myrtaceae in the Malesian and south-east Asian areas, and Africa. It arrived in both New Caledonia and South Africa in 2013.

Myrtle Rust spores are naturally wind- and animal-borne. There are however strong indications that much of the long-distance spread within Australia has resulted from human movement of infected plant material. Extreme vigilance in the greenlife industry and among non-commercial plant growers is vital in the uninfected areas of the country. Some restrictions on the inter-state movement of Myrtaceae plants and products are in place—see your Primary Industries departmental websites for details. Spores can also be moved on people and clothing. If you have been in infected vegetation, laundering of clothes and disinfection of tents, tarps, hats etc is needed before travelling to uninfected States or areas, especially if you intend to visit nurseries or bushland—see the websites above for guidelines.

There are several overseas variants ('pathotypes') of this fungal pathogen. They differ in their host-species preferences and severities, but are only very recently beginning to be studied in detail. The potential arrival in Australia of further strains is a big worry.

300 native host species…and counting

We appear to have only one variant of *Puccinia psidii* in Australia so far, but it is proving to be bad enough. In just four years it has proved capable of infecting more than 300 native Australian Myrtaceae species as hosts. This is an extraordinarily wide host-range—most rusts have only one or a few. Australia has about 2,250 native species of Myrtaceae, and approximately half of these occur in the climatic areas assessed as broadly suitable for Myrtle Rust establishment.

So far, only a minority of host species are severely affected, although it is still early days and very few species have been scrutinised for susceptibility at critical life-stages like seedlings and resprouts, as distinct from seasonal growth. Even among those species that are highly susceptible, severity varies depending on growth stage and climatic conditions (the fungus needs damp nights and moderately warm temperatures). Myrtle Rust attacks mainly new leaf and shoot growth, i.e. seedlings, seasonal flush or resprouts. In some species it also attacks the flowers and in some soft-fruited genera, the fruits. Effects can include death of seedlings, eventual defoliation of older plants, and reduced reproductive capacity especially for those species that flower on younger shoots. Myrtle Rust does not make plants drop dead suddenly (except seedlings), but the attrition effects are cumulative. Death of adult plants after 2-3 years of repeated infections is now being recorded in a couple of highly susceptible shrub species.

Resistance to *Puccinia psidii* in several forestry eucalypt species grown in South America is relatively well documented, and has been bred into new clonal lines for some plantation species and hybrids. Disease-tolerant or 'resistant' plants or populations are also being detected in a few of the new Australian non-eucalypt host species, but the genetic and physiological bases of resistance are only now coming under study, and only for a very few taxa—resources are lacking for comprehensive survey and the necessary genetic analysis and selection trials except for commercially significant species. The heritability of resistance, even where it is present, may not be straightforward. In many or most wild populations of highly susceptible species it is very doubtful whether natural selection, to favour resistant genotypes, will kick in in time to compensate for demographic decline caused by the Rust, or without a drastic narrowing of the gene pool, either of which would add to the impacts of other threatening processes.

A few highly susceptible species are already showing signs of severe decline. Native Guava (*Rhodomyrtus psidioides*) and Scrub Turpentine (*Rhodamnia rubescens*) are widespread shrub species of moist sclerophyll forests along the coasts of NSW and QLD. Prior to the arrival of Myrtle Rust, they were of no conservation concern. Both are highly susceptible to Myrtle Rust. Strong evidence is now emerging that they are undergoing severe decline in normal growth and reproductive capacity (G. Pegg and A. Carnegie, work in progress). Many legislatively listed species in the same states are also likely to undergo decline.

Of great concern are the three broadleaved paperbark species that are important, sometimes dominant, trees across huge areas of coastal floodplain and river margins in eastern and tropical Australia: *Melaleuca quinquenervia*, *M. leucadendra* and *M. viridiflora* are all highly susceptible on their new growth.

The potential long-term effects on eucalypts are unclear. Some 80 eucalypt taxa, not counting hybrids, are recorded as susceptible (69 taxa in Eucalyptus, eight in *Corymbia*, and three in *Angophora*). However, in *Eucalyptus* itself a majority of these records are from experimental trials in the lab, including on non-east coast species, and only a minority have infection confirmed in the wild so far. No eucalypts are regarded as highly susceptible at this point, but there is a lack of observations for nearly all species on the critical life stages of seedlings and coppice growth (e.g. post-fire epicormic shoots).

The impacts of *Puccinia psidii* in Australia will become fully evident over a multi-decade time frame—only the earliest stages of impact are yet evident. It is not alarmist to forecast the extinction in the wild of a significant number of species as a direct result of this disease. Management of the pathogen in the wild is extremely problematic except at very small scales—fungicides are effective in cultivation but environmentally damaging in bushland. No effective broad-scale mitigation is in prospect for most wild situations. Accordingly there is no likelihood of eradication in bushland areas of entrenched naturalisation, and only a limited likelihood of practical mitigation in bushland.

Exotic Rust disease on Myrtaceae has been listed as a key Threatening Process in NSW since 2012. A nomination was submitted in March 2014 for a similar listing under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*.

*Mature small trees of Native Guava (*Rhodomyrtus psidioides*) killed by repeated infections of Myrtle Rust, west of Byron Bay, NSW. Photos: K. Kupsch*

Government and industry responses to date

The initial emergency response in 2010 was funded and coordinated at Commonwealth level, and was led in all jurisdictions by the primary industries agencies. From early 2011 to 2014, responsibility was devolved to the States, with some continued coordination, and limited but crucial Commonwealth funding for some aspects of basic research into the genetics, phylogeny and life cycle of the pathogen, the genetics of resistance in a few host species, and chemical treatment options for the greenlife industries. The primary industries agencies have all produced brochures and websites with good awareness and recognition guides, and advice on vigilance, reporting, hygiene and treatments in cultivation. Yet information flow remains somewhat fragmented. For example, no agency has taken on the maintenance of a consolidated national host list, although one has been maintained informally by dedicated primary industries people.

Nursery & Garden Industry Australia has produced a comprehensive Myrtle Rust Management Plan (www.ngia.com.au) that is an indispensable resource for all commercial and community nurseries and the greenlife industry as a whole. Roads & Maritime Services NSW has produced biodiversity guidelines (www.rms.nsw.gov.au/environment/downloads/biodiversity_guidelines.pdf) with a general but useful section on Myrtle Rust precautions for staff and contractors, which could also be used as a template for procedures by other utilities and organisations.

The response of the environment agencies has been uneven and limited, partly because the natural and legislative lead role rests with the primary industries agencies (who have most of the plant disease expertise). Some states have produced 'bushland management' guidelines (NSW, QLD, and WA in prep.) Unfortunately a big gap has developed in preparing for the disease on the environmental (bushland) front, and in assessing its actual environmental impacts. The only active research on natural-system impacts is being driven by individual scientists within the Queensland and NSW primary industries agencies, assisted by people at a couple of universities and by informal non-government networks. No environment or conservation agency has yet launched any research of this sort, or baseline-knowledge assessments for the Myrtaceae (with the partial exception of the former Queensland Department of Environment and Resource Management before its dismemberment).

The environment agencies have however supported awareness activity, including in some States the Australian Network for Plant Conservation's training course (see below). The government conservation seed banks, grouped under the Australian Seed Bank Partnership and mostly administered by the major botanic gardens, have re-prioritised the collection of seed of potentially vulnerable Myrtaceae, within their current limited resources—but in few cases has this yet reached the level of really large and comprehensive collections for any but very localised species. Staff at some of the main botanic gardens have also been heavily involved in research, technical advisory, and training and awareness roles.

National coordination continues to be a problem. The Commonwealth-supported 'Transition to Management' program of 2011–13 is now unfunded, and no agency has picked up the baton for this role. The Council of Australian Governments' Standing Councils for Primary Industries (PISC) and Environment and Water (SCEW) were both abolished in late 2013, which may make the facilitation of the national response more difficult.

Australian Network for Plant Conservation's response

The Australian Network for Plant Conservation (ANPC) engaged with the Myrtle Rust problem from an early stage. A comprehensive one-day training module was developed in 2010–11, in partnership with the Royal Botanic Gardens Sydney, and has been delivered at 19 sessions in NSW, Queensland, WA and on Lord Howe Island, equipping some 525 people with detailed knowledge of the disease. These training events have been delivered with practical and some financial support from both the primary industry and environmental agency in each jurisdiction, and with invaluable support from the Rural Industries Research & Development Corporation and the Bjarne K Dahl Trust. This training course capability remains available for other States and regions.

Cut-down, seminar-scale versions of the ANPC course have also been delivered at the Albury Botanic Gardens Australia and New Zealand conference in 2011, the Papua New Guinea Biological Society conference in 2012, and at an informal botanical gathering in Java, Indonesia in 2012 (the latter two by Dr Barry Conn of Royal Botanic Gardens Sydney, on ANPC's behalf).

The background material on the ANPC website is now out of date, and will be refreshed in coming months, including a comprehensive bibliography and a version of the current national host list.

Myrtle Rust is not to be confused with 'Myrtle Wilt'; a fungal disease of Myrtle Beech (*Nothofagus cunninghamii*, family Nothofagaceae) caused by the pathogen *Chalara australis*—see www.soln.org/wp-content/uploads/2009/06/myrtlewiltfactsheet-2005.pdf, and soer.justice.tas.gov.au/2009/copy/49/index.php for further information.

Futher Reading

Australian Seed Bank Partnership (ASBP) website: www.seedpartnership.org.au.

ANPC member profiles

Martin Driver

Workplace: Australian Network for Plant Conservation
Role: Project Manager

Hello to all the members of the Australian Network for Plant Conservation (ANPC)! My name is Martin Driver, and I would like to introduce myself as the newly appointed Project Manager for the ANPC.

I am delighted to take up this position and look forward to working with you all to promote and enhance plant conservation in Australia. I'd also like to take a moment to acknowledge the efforts of all staff, past and present in all the good work that has gone into ANPC to this point.

I have spent the last thirty years working on private and community vegetation management, enhancement and restoration projects, mostly in NSW. My professional life commenced in 1976 with *CSIRO Division of Rangelands Research and Wildlife and Ecology*. This gave me a great grounding in research, focusing on field disturbance ecology, grazing management, fire ecology, native plant and seed ecology, restoration and management. I also assisted with the publication of *Plants of Western NSW*, a tome still widely acknowledged as 'The Bible'. My time with CSIRO not only established a great love for the arid and semi-arid landscapes and their flora, but also a strong empathy for the role of land managers and the importance of field extension and needs-based training.

After leaving CSIRO I worked for *Greening Australia* and *Murray Indigenous Seed Services* and its various iterations, and later the Murray Catchment Management Authority (CMA), in initiating native vegetation extension and incentive programs to meet the needs of the various land tenures, their managers and the vegetation.

I have enjoyed working with a wide range of land managers from private landholders, local government, state authorities, and corporate infrastructure companies in meeting their knowledge and management needs. I believe I bring a wealth of experience and hard learnt 'tricks and techniques' to get better on-ground vegetation outcomes with fewer resources.

Whilst working as the Regional Manager for Greening Australia, I came to realise that the effectiveness of re-vegetation management was severely limited by the availability, quantity and quality of native plant seed. For this reason, I have long advocated the importance of regional, catchment or community based seed supply networks. These networks have proven to be vital for effective broad-scale native vegetation establishment and the adoption of cost-effective direct seeding site enhancement. They also provide an avenue for training in and development of suitable re-vegetation methods.

Martin Driver, Project Manager, Australian Network for Plant Conservation. Photo: Ella Driver.

It concerns me that the role of native seed supply in some restoration works is often dealt with as an afterthought in project development, and is not given the consideration and support it deserves. The absolute imperative of having the 'right seed' for a project, to me, is vital for its success in meeting biodiversity objectives. The whole project development and seed supply chain needs to be supported by sound science and good policy, practice and extension—and funding.

I have also long recognised the importance of those areas of remnant vegetation in our predominantly cleared agricultural areas of Australia, whatever the current quality. I particularly look to the opportunities that our extensive publicly-owned linear reserves, road and infrastructure corridors and stock routes hold for maintaining and extending our biodiversity in depleted landscapes. These areas intersect virtually our entire landscape and often hold the only relicts of past landscapes, as well as the threads of future restoration opportunities through provision of seed and other genetic material. They are in many areas our de facto national parks and botanic gardens of the bush.

I also own a commercial dry-land grazing enterprise in the NSW Riverina and have incorporated many regeneration and restoration strategies into its operation. I am passionate about the production and the ecological roles of native vegetation in agricultural landscapes and in supporting all landowners to meet their objectives in management and restoration.

I look forward to maintaining my old networks and forming new networks by linking people and organisations across all areas of experience and expertise in plant conservation.

Chantelle Doyle

Workplace: Greening Australia NSW
Role: Project Manager

What projects are you working on at the moment?

My role involves coordinating and implementing a number of targeted bush regeneration and habitat restoration programs within the Sydney Basin Cumberland Plain region. In addition, I am fortunate enough to undertake field data collection as part of landscape scale projects, such as rehabilitation monitoring using Landscape Function Analysis (LFA). LFA was developed by David Tongway and Norman Hindley at CSIRO in 2005 and uses a comprehensive metric to assess the stability, nutrient cycling and woody biomass on rehabilitating sites. Although LFA does not capture diversity or species specific information, the indices produced can be tracked, largely objectively, over an extended time period to assess the functioning of a site as it is restored. Originally designed with mine sites and rangelands in mind, we are currently using LFA indices to benchmark intact remnant vegetation and provide rehabilitation targets for biodiversity offset zones.

Another large interstate project in which I had the pleasure of digging over 300 core holes, is the Tops Soils program. This is run in collaboration with the East Gippsland Catchment Management Authority (CMA), Landcare, Southern Farming Systems and the Victorian Department of Environment and Primary Industry (DEPI). Tops Soils aims to build on preliminary soil characterisation synthesis, commenced in the 1990s by DEPI, to develop an interactive map of soils across the East Gippsland region. Over 150 landholders have participated so far, with the results aiming to inform their land management decisions. These decisions will be based on identifying inherent limitations in soils and may include changes in land use such as where to crop or graze and what areas to revegetate.

On a local scale the fantastic Scarlet Robin Habitat Reconstruction program (featured in edition 22(2) of APC), developed by Parramatta City Council in Western Sydney, has extended to include three additional foraging 'islands'. These are being established to meet the niche seasonal foraging patterns of the threatened Scarlet Robin, and more generally the diverse requirements of a suite of small insectivorous woodland birds. The islands include log piles with shrubs, log piles with grasses and log piles with no vegetation.

The area has also undergone a small but intensive woody weed eradication program and an ecological burn. The woody weed removal primarily focused on Small-leaf Privet and Blackberry which dominated the site as dense, heavily shaded monocultures. These were aggressively removed in less than one day through forest mowing, which involved mulching of vegetation standing up to eight metres high. Since clearing seedbank response has been astounding given the area has been recorded as farmland since the 1920s. Native Grape (*Cayratia clematidea*), Weeping Grass (*Microleana stipoides*), Whiteroot (*Pratia purpurascens*), Basket Grass (*Oplismenus aemulus*) and Plume Grass (*Dichelachne micrantha*) are all appearing and have seeded twice this year. Equally our subsequent revegetation works have produced pockets of Barbed Wire Grass (*Cymbopogon refractus*) and Kangaroo Grass (*Themeda triandra*) standing over my head (although I am not often described as tall).

The ecological burn in contrast was nearly a year in the making, as urban fires are rarely permitted by either councils or by the NSW Environmental Protection Authority. Nevertheless this burn went off without a hitch in early May 2014 and involved 15 small woody debris piles, collected and accumulated from the woody weed removal activities nine months earlier. The burn aimed to stimulate native seed, particularly Fabaceae species, which are noted in the Cumberland Plain of western Sydney to be fire responsive.

Although there is not a formal budget to monitor the germination response, one of the local bird watching groups, supporting by Parramatta City Council, is assisting in the monitoring of the habitat piles and producing a photographic record of burnt versus unburnt squares (1 m x 1 m). Small top soil samples from burnt and unburnt areas are also being monitored under nursery conditions to examine the species mix over the next 12 months.

How long have you been a member of ANPC?

I joined the ANPC in 2013 after being inspired in part by colleagues within Greening Australia and by my exploration of the network's ethos and pragmatism. Far from being inaccessible, I found the blend of industry, research and case study features to provide a realistic and holistic picture of conservation and restoration activities across Australia. The combination of relevant publications and the reviews of related resources also encouraged me, demonstrating a network with both local and broad-scale focus.

The September–November 2013 APC edition, which carried the theme 'Value of plant conservation to animals' also prompted me to share some of the programs Greening Australia is undertaking. I got active; co-authoring a small case study (Doyle et al. 2013), and joining the ANPC.

How did you end up working in plant conservation? (What/who inspired you?)

As with many people, my interest in plant diversity was cultivated in childhood. My mother was always collecting cuttings and experimenting with propagation. The memories of both of these enchanted me. Many plants were donated from the gardens of relatives and collected on holidays in far flung regions. This translated to my university days, when our garden was entirely comprised of plant fragments collected from overhanging branches and bushes!

As a former extension officer with the Queensland Murray Darling Committee, I enjoyed exploring the value of native plants, particularly pastures, in productive grazing systems and got great pleasure from sharing some of the 'utilities' native systems provide. Grazing sensitive grasses and forbs were my particular favourite as their presence could rapidly help demonstrate sustainable stocking pressures.

The intersection between diversity and production, whether it be urban living or rural agriculture, has always appealed to me as both a necessary and logical goal for conservation action. The activities and priorities of Greening Australia nationally often address both urban and rural conservation and community engagement.

Are you involved in any conservation activities in your spare time?

I have recently completed my Masters thesis which utilised the *Atlas of Living Australia* (ALA; www.ala.org.au) to identify the habitat environmental envelope of Nodding Chocolate Lily (*Dichopogon fimbriatus*). This study demonstrated that the ALA is a valuable and easily accessible open source resource, capable of identifying the climatic envelope and habitat niches of *D. fimbriatus* through use of the Habitat Suitability Model, MaxEnt. I encourage all readers who haven't experimented with the ALA spatial analyst portal to begin exploring. These results and a brief critique of the ALA portal are also, slowly, being assembled into a small publication, although the editing process is proving challenging! Did I mention this would make a great future APC article?

Where possible I also volunteer with the NSW National Parks & Wildlife Service on a variety of fauna field surveys, most recently having assisted harp netting microbats and mapping wombats in South Western Sydney.

My passion for native pastures in productive grazing systems is not being neglected this year either. 2014 is my target year to publish a small case study on the responses of pastures to flooding. This is based on data collected by Col Paton (EcoRich Grazing) and myself monitoring the response of native and improved pastures along the Maranoa-Balonne River after the enormous 2011 flooding event in Queensland. Entitled 'Keeping our heads above water' the findings, highlighting the importance of a heterogeneous pasture, have already been presented by my colleague at the 2012 Northern Beef Research Update Committee (NBRUC),

Further reading

Doyle, C., Macris, C. and Freemanis A. (2013). Restoring reserves in the heart of Western Sydney: habitat reconstruction for the threatened Scarlet Robin. *Australasian Plant Conservation* 22(2).

Tongway, D.J. and Hindley, N.L. (2005). *Landscape Function Analysis: Procedures for Monitoring and Assessing Landscapes, With special reference to Minesites and Rangelands.* CSIRO Australia.

Workshop report

Tricia Hogbin

In April 2014, the Australian Network for Plant Conservation (ANPC) delivered two workshops in the NSW Hunter Valley. The first was a two-day workshop titled *Plant identification for flora of the Hunter Valley*. The second was a one-day workshop titled *Seed collection, storage and use for native vegetation restoration*.

Bob Makinson teaches plant identification workshop participants how to use botanical keys by creating a key to the participants themselves (standing are the 'species' with orange or reddish 'bark').

Harry Rose from the NSW Department of Primary Industries demonstrates how to collect a herbarium specimen and maintain a plant press.

As is typical for ANPC workshops, a key strength was the diversity of presenters and participants involved. The ANPC would like to acknowledge and thank the support of the following workshop presenters: Stephen Bell, Eastcoast Flora Survey; Graeme Errington, Royal Botanic Gardens and Domain Trust (RBG & DT); Paul Gibson-Roy, Greening Australia; Nola Hancock, Macquarie University; Teresa James, flora consultant; Bob Makinson, RBG & DT; Paul Melehan, Hunter Local Land Service; John Moen, Antechinus Environmental Services; Harry Rose, NSW Department of Primary Industries; and Karen Sommerville, RBG & DT. The ANPC would also like to acknowledge the support of Hunter Local Land Services, who contributed funds towards delivery of the seed workshop.

Seed workshop participant Kirsten McKimmie tests seed viability using the cut test (top), and a range of equipment that can assist in seed collection, provided by Graeme Errington (bottom).

Workshop report (cont.)

Limits to the effective and efficient use of seed in the Hunter catchment identified

The *Seed collection, storage and use for native vegetation restoration* workshop closed with a discussion titled 'Limits to the effective and efficient use of seed in the Hunter catchment and strategies to overcome these limits'. The workshop identified six factors which limit effective and efficient use of seed in the Hunter catchment (and which are likely to apply in many areas of Australia). Those factors were:

- the price that seed users are willing to pay for good quality local seed
- a lack of appreciation for the time it takes to collect and process high quality diverse local seed
- fluctuations in seed availability and seed demand
- availability of machinery to mechanically harvest large volumes of seed
- not being able to readily determine what seed is already available
- a poor understanding of best-practice techniques in direct seeding.

Six strategies identified to overcome these limits were:

- ensure sufficient funds and time are allowed for sourcing seed for restoration projects
- promote the benefits of using good quality seed of appropriate provenance
- manage fluctuations in seed availability and seed demand by establishing; a regional seed bank, seed production areas, and restoration sites and natural areas which are managed for seed production
- establish a pool of regional machinery and equipment for harvesting large numbers of seed
- develop a regional seed database
- provide training in best-practice techniques for direct-seeding restoration.

A report detailing this discussion session and follow-up liaison with local seed collectors and other restoration practitioners is available from the workshop webpage, at http://www.anbg.gov.au/anpc/courses/huntervalley2014/seed.html. Additional information on past and upcoming workshops can be found at: http://www.anpc.asn.au/courses.html

Plant identification workshop participants practicing their plant identification skills, keying out specimens using interactive electronic keys (left), and Paul Melehan (standing) from Hunter Local Land Services helping participants identify the main parts of a flower (right).

Upcoming conferences and workshops

19th Australasian Weeds Conference

1–4 September 2014
Hobart, Tasmania

The Tasmanian Weeds Society, in conjunction with the Council of Australasian Weeds Societies Inc. will host the 19th Australasian Weeds Conference. The overall theme is: 'Science, Community and Food Security: the Weed Challenge'. For more information visit http://australasianweeds2014.com.au/

2014 National Landcare Conference

17–19 September 2014
Melbourne, Victoria

Landcarers across the country are invited to register for this year's quarter-century anniversary conference. The conference program focuses on the theme of 'Celebrating our history, growing our future'. For more information visit http://www.landcareonline.com.au/nationalconference

Ecological Society of Australia 2014 Annual Conference

28 September – 3 October 2014
Alice Springs, Northern Territory

The conference is targeted at ecologists, policy makers and land managers and includes a diverse range of topical and timely symposia topics, including integrating conservation with food production through off-reserve conservation; adaptive management: bridging the gap between decision theory and practice; and monitoring for managing biodiversity.

The full program and more information is available at http://www.esa2014.org.au/

Botanic Gardens of Australia and New Zealand Biennial Conference

2–4 October 2014
Cairns, Queensland

The Botanic Gardens Australia and New Zealand promotes the interests and activities of Australian and New Zealand botanic gardens and enhances the state of botanic gardens for the benefit of the community. This year's conference theme is 'cultivating connections'.

For more information visit http://www.bganz.org.au/

The 17th Box-Ironbark Ecology Course

6–10 October 2014
Nagambie, Victoria

This five-day course is for anyone interested in gaining a general understanding of the ecology of Box-Ironbark ecosystems. The course includes a diverse range of topics and will provide participants with practical skills in survey, monitoring and management. For more information, contact course coordinator Kate Stothers: email: katelance1@gmail.com, mobile: 0458 680 990.

10th Australasian Plant Conservation Conference

11–14 November 2014
Hobart, Tasmania

The 10th Australasian Plant Conservation Conference, hosted by the Australian Network for Plant Conservation and the Royal Tasmanian Botanic Gardens, will provide a forum for conservation practitioners, community members and the scientific community to interact at a practical level. The overall theme of the 2014 conference is 'Sustaining Plant Diversity–Adapting to a Changing World'. Sub-themes include: securing biodiversity, prioritising actions, animals in plant conservation and engagement and communication in the modern world. For more information visit http://www.anpc.asn.au/conferences/2014/

IUCN World Parks Congress

12–19 November 2014
Sydney, New South Wales

The IUCN World Parks Congress 2014 is a landmark global forum on protected areas. The Congress will share knowledge and innovation, setting the agenda for protected areas conservation for the decade to come. Building on the theme 'Parks, people, planet: inspiring solutions', it will present, discuss and create original approaches for conservation and development, helping to address the gap in the conservation and sustainable development agenda. For more information visit http://www.worldparkscongress.org/

Upcoming conferences and workshops (cont.)

Society for Ecological Restoration Australasia (SERA) 2014 conference

17–21 November 2014
New Caledonia

This conference aims to bring together land managers, scientists and practitioners who work in biodiversity restoration at a time of significance for the region's species, ecosystems and landscapes with a focus on restoration of degraded sites, in particular in island regions. These meetings provide a critical platform to assist us in defining the principles of restoration, understanding goals and milestones, debating what ecosystem functions to measure and closing the gap between the science of restoration ecology and the practice of ecological restoration.

For more information visit: http://www.seraustralasia.com/pages/conference.html

Information resources and useful websites

Sciencengage

http://sciencengage.com.au/

Sciencengage is a national database of over 400 science engagement activities, projects. Be inspired (by projects like Poo Power—which seeks innovative solutions to dealing with the 1350 tonnes of canine poo generated daily in Australia), join in an activity, or login to add your own science engagement activity.

ALERT- Alliance of Leading Environmental Researchers & Thinkers

http://alert-conservation.org/

ALERT aims to help world-class scientists to influence key environmental decisions. They promote and disseminate cutting-edge environmental research to the public, journalists and other scientists through a range of media including their regular 'Issues and research highlights'. You can follow their updates on social media or subscribe to email updates.

Communities for Communities Newsletter

http://www.environment.gov.au/biodiversity/threatened/publications/communities-newsletter

Communities for communities is a newsletter produced by the Australian Government Department of the Environment. The newsletter will help keep you informed about threatened ecological communities listed and nominated for listing under the *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) and related information available on the department's web site.

Indigenous Biocultural Knowledge website

http://aibk.info/

This new website aims to draw attention to the wealth of projects, research and management plans where Indigenous biocultural knowledge has been used to improve our understanding of Australian ecology and land management practices. Many Indigenous people and their non-Indigenous colleagues have and are working on a range of projects to manage and understand Country using Indigenous biocultural knowledge and western science. This website offers an indicative map of where these projects have been documented and provides examples of current leading practice, review material, related resources and case studies of 'living' knowledge and projects that have not been documented.

Research round up

Compiled by Kirsten Cowley

Centre for Plant Biodiversity Research, Canberra. Email: Kirsten.Cowley@csiro.au

Abasolo, M., Lee, D.J., Brooks, L., Raymond, C. & Shepherd, M. (2014). **Genetic control of flowering in spotted gum, *Corymbia citriodora* subsp. *variegata* and *C. maculata*.** *Australian Journal of Botany* 62: 22-35.

Baker, T.P., Jordan, G.J., Dalton, P.J. & Baker, S.C. (2013). **Impact of distance to mature forest on the recolonisation of bryophytes in a regenerating Tasmanian wet eucalypt forest.** *Australian Journal of Botany* 51: 633-642.

Bennett, J.R., Elliott, G., Mellish, B., Joseph, L.N., Tulloch, A.I.T., Probert, W.J.M., Di Fonzo, M.M.I., Monks, J.M., Possingham, H.P. & Maloney, R. (2014). **Balancing phylogenetic diversity and species numbers in conservation prioritization, using a case study of threatened species in New Zealand.** *Biological Conservation* 174: 47-54.

Bezemer, N., Kirkpatrick, J.B. & Wood, J.A. (2013). **The effect of recent fire history on the abundance and viability of large seeds in the soil of sclerophyll forest in Tasmania, Australia.** *Papers and Proceedings of the Royal Society of Tasmania* 147: 41-50.

Bull, J.W., Gordon, A., Law, E.A., Suttle, K.B. & Milner-Gulland, E.J. (2014). **Importance of baseline specification in evaluating conservation interventions and achieving no net loss of biodiversity.** *Conservation Biology* 28(3): 799-809.

Coleby, D. (2014). **Further observation on ecology of *Blandfordia cunninghamii*: flowering responses to rainfall and fire, and juvenile growth rates.** *Cunninghamia* 14: 55-61.

Crane, C.E. & Shearer, B.L. (2014). **Comparison of phosphite application methods for control of *Phytophthora cinnamomi* in threatened communities.** *Australasian Plant Pathology* 43: 143-149.

Etherington, R. & Shapcott, A. (2014). **Do habitat fragmentation and fire influence variation of plant species composition, structure and diversity within three regional ecosystems on the Sunshine Coast, Queensland, Australia?** *Australian Journal of Botany* 62: 36-47.

Fensham, R.J., Silcock, J.L. & Firn, J. (2014). **Managed livestock grazing is compatible with the maintenance of plant diversity in semidesert grasslands.** *Ecological Applications* 24(3): 503-517.

Gauli, A., Vaillancourt, R.E., Steane, D.A., Bailey, T.G. & Potts, B.M. (2013). **Effect of forest fragmentation and altitude on the mating system of *Eucalyptus pauciflora* (Myrtaceae).** *Australian Journal of Botany* 61: 622-632.

Gibson-Roy, P. & McDonald, T. (2014). **Reconstructing grassy understories in south-eastern Australia: interview with Paul Gibson-Roy.** *Ecological Management & Restoration* 15(2): 111-122.

Gill, A.M., Sharples, J. & Johnstone, G. (2014). **Edge effects on between-fire interval in landscape fragments such as fire-prone terrestrial conservation reserves.** *Biological Conservation* 169: 54-59.

Gooden, B. & French, K. (2014). **Impacts of alien grass invasion in coastal seed banks vary amongst native growth forms and dispersal strategies.** *Biological Conservation* 171: 114-126.

Griffiths, E. & Stevens, J.C. (2013). **Managing nutrient regimes improves seedling root-growth potential of framework banksia-woodland species.** *Australian Journal of Botany* 51: 600-610.

Guja, L.K., Merritt, D.J., Dixon, K.W. & Wardell-Johnson, G. (2014). **Dispersal potential of *Scaevola crassifolia* (Goodeniaceae) is influenced by intraspecific variation in fruit morphology along a latitudinal environmental gradient.** *Australian Journal of Botany* 62: 56-64.

Hallett, L.M., Standish, R.J., Jonson, J. & Hobbs, R.J. (2014). **Seedling emergence and summer survival after direct seeding for woodland restoration on old fields in south-western Australia.** *Ecological Management & Restoration* 15(2): 140-146.

Hodgins, K. (2014). **Unearthing the impact of human disturbance on a notorious weed.** *Molecular Ecology* 23: 2141-2143.

Iftekhar, M.S., Tisdell, J.G. & Gilfedder, L. (2014). **Private lands for biodiversity: Review of conservation covenanting programs in Tasmania, Australia.** *Biological Conservation* 169: 176-184.

Jellie, Z.V., Wills, T.J., Kutt, A.S., Hemming, V.L., King, D.J., McKenzie, V.J., Retallick, R.W.R., Timewell, C.A. & van Eeden, L. (2014). **Experimental slab salvage and reinstatement after pipeline construction in a threatened grassland community.** *Ecological Management & Restoration* 15(2): 161-165.

Research round up (cont.)

McCallum, K.P., Guerin, G.R., Breed, M.F. & Lowe, A.J. (2014). **Combining population genetics, species distribution modelling and field assessments to understand a species vulnerability to climate change.** *Austral Ecology* 39: 17-28.

McCartney, V.A., Silvester, E., Morgan, J.W. & Suter, P.J. (2013). **Physical and chemical drivers of vegetation in groundwater-source pools on the Bogong High Plains, Victoria.** *Australian Journal of Botany* 61: 566-573.

McKillup, S.C. & McKillup, R.V. (2013). **Fire does not stimulate flowering of the grasstree *Xanthorrhoea latifolia* subsp. *latifolia* in central Queensland.** *Australian Journal of Botany* 61: 558-565.

Neldner, V.J. & Ngugi, M.R. (2014). **Application of the BioCondition assessment framework to mine vegetation rehabilitation.** *Ecological Management & Restoration* 15(2): 158-161.

Oduor, A.M.O. (2013). **Evolutionary responses of native plant species to invasive plants: a review.** *New Phytologist* 200: 986-992.

Schinagl, H., Wright, W. & Rayment, P. (2013). **Recruitment of *Eucalyptus strzeleckii* (Myrtaceae) in remnant patches of native vegetation in the Latrobe Valley and South Gippsland, Victoria.** *Australian Journal of Botany* 51: 654-662.

Shearer, B.L. & Crane, C.E. (2014). **Host range of the stem canker pathogen *Luteocirrhus shearii* mainly limited to *Banksia*.** *Australasian Plant Pathology* 43: 257-266.

Shearer, B.L., Crane, C.E., Fairman, R.G., Dillon, M.J. & Guehrig, R.M. (2014). **Spatio-temporal variation in invasion of woodlands and forest by *Phytophthora cinnamomi*.** *Australasian Plant Pathology* 43: 327-337.

Shepherd, J. & Keyzer, V. (2014). **Ecology of *Eucalyptus aquatica* (Myrtaceae), a restricted eucalypt confined to montane swamp (fen) habitat in south-eastern Australia.** *Cunninghamia* 14: 77-87.

Sonter, L.J., Barrett, D.J. & Soares-Filho, B.S. (2014). **Offsetting the impacts of mining to achieve no net loss of native vegetation.** *Conservation Biology* DOI: 10.1111/cobi.12260

Stanton, P., Parsons, M., Stanton, D. & Stott, M. (2014). **Fire exclusion and the changing landscape of Queensland's Wet Tropics Bioregion 1. The dynamics of transition forests and implications for management.** *Australian Forestry* 77(1): 58-68.

Swarts, N.D., Clements, M.A., Bower, C.C. & Miller, J.T. (2014). **Defining conservation units in a complex of morphologically similar, sexually deceptive, highly endangered orchids.** *Biological Conservation* 174: 55-64.

Tedesco, P.A., Bigorne, R., Bogan, A.E., Giam, X., Jezequel, C. & Hugueny, B. (2014). **Estimating how many undescribed species have gone extinct.** *Conservation Biology* DOI: 10.1111/cobi.12285

Tehranchian, P., Adair, R.J. & Lawrie, A.C. (2014). **Potential for biological control of the weed Angled Onion (*Allium triquetrum*) by the fungus *Stromatinia cepivora* in Australia.** *Australian Plant Pathology* DOI 10.1007/s13313-014-0279-6

Turner, S.R. (2013). **Seed ecology of *Lepidosperma scabrum* (Cyperaceae), a dryland sedge from Western Australia with physiological seed dormancy.** *Australian Journal of Botany* 61: 643-653.

Westwood, A., Reuchlin-Hugenholtz, E. & Keith, D.M. (2014). **Re-defining recovery: a generalized framework for assessing species recovery.** *Biological Conser*vation 172: 155-162.

Wevill, R. & Florentine, S.K. (2014). **An assessment of riparian restoration outcomes in two rural catchments in south-western Victoria: Focusing on tree and shrub species richness, structure and recruitment characteristics.** *Ecological Management & Restoration* 15(2): 133-139.

Whinam, J., Abdul-Rahman, J.A., Visoiu, M., di Folco, M.-B.F. & Kirkpatrick, J.B. (2014). **Spatial and temporal variation in damage and dieback in a threatened subantarctic cushion species.** *Australian Journal of Botany* 62(1): 10-21.

Williamson, G.J., Murphy, B.P. & Bowman, D.M.J.S. (2014). **Cattle grazing does not reduce fire severity in eucalypt forests and woodland of the Australian Alps.** *Austral Ecology* 39: 462-468.

Wilson, N. & Gibbons, P. (2014). **Microsite factors influencing *Eucalyptus* regeneration in temperate woodlands.** *Ecological Management & Restoration* 15(2): 155-157.

Contributions to Research Roundup are welcome, and should be sent to Kirsten Cowley at the above email address using an email subject heading "APC Research Roundup" or similar. Their inclusion will be subject to available space.

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ANPC gratefully acknowledges the support of the following corporate members:

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KEYNOTE SPEAKER:

Professor Ian Lunt,
Charles Sturt University

PLENARY SPEAKERS:

Professor David Bowman,
University of Tasmania

Dr Terry Walshe,
Australian Institute of Marine Science

Professor Jonathon Majer,
Curtin University

Andrew Smith, Tasmanian Parks and Wildlife Service

Photos (left to right): *Tetratheca gunnii*, a Tasmanian endangered species; *Richea scoparia*, an abundant alpine plant endemic to Tasmania. Photos: Royal Tasmanian Botanical Gardens